these are typically designed as bandpass filters which are used for suppressing the image frequency. In the technology previously available, the selectivity of a single bandpass filter was insufficient at the image frequency which is why two bandpass filters had to be used.

A first bandpass filter (FF), the front-end filter, usually had less selectivity and lower insertion loss in the useful band and was placed in front of the low-noise preamplifier (LNA). A second bandpass filter (IF), the so-called interstage filter, has higher selectivity and was placed between the preamplifier and the first mixer. This use of two bandpass filters in the front-end and interstage area made it possible to achieve adequate selectivity at the image frequency.

The present invention is directed toward specifying a solution to this problem which is as inexpensive as possible and which also is associated with a smaller space requirement than the known solutions involving two bandpass filters.

SUMMARY OF THE INVENTION

Accordingly, in an embodiment of the present invention, a heterodyne mobile radio receiver is provided which includes a highly selective front-end filter preceding a low-noise input amplifier, and a high-pass filter which follows the low-noise input amplifier and precedes a first mixing stage.

In an embodiment, the heterodyne mobile radio receiver includes a highly selective front-end filter preceding a low-noise input amplifier, and a low-pass filter which follows the low-noise input amplifier and precedes a first mixing stage.

In a further embodiment, the heterodyne mobile radio receiver includes a highly selective front-end filter preceding a low-noise input amplifier, and an offset compensation part which follows the low-noise input amplifier and precedes a first mixing stage.

Additional features and advantages of the present invention are described in, and will be apparent from, the following Detailed Description of the Invention and the Figures.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 diagrammatically shows the configuration of a heterodyne receiver according to the present invention.

Figure 2 diagrammatically shows the configuration of a heterodyne receiver previously used.

DETAILED DESCRIPTION OF THE INVENTION

Due to more recent developments in the field of bandpass filters, modern bandpass filters have, at present, a higher selectivity at the image frequency than was previously achievable. Extensive trials and simulations by the inventors have shown that it is possible to configure a heterodyne receiver in a simplified manner via bandpass filters of this novel type. For this purpose use is made of a bandpass filter having a very high adjacent-channel selectivity such as previously has been used in principle as interstage filter; i.e., as bandpass filter between the preamplifier and the first mixing stage. However, the novel front-end filter according to the present invention is distinguished by extremely high adjacent-channel selectivity which previously has not been available.

By using such a front-end filter, it is sufficient to use a simple low-pass filter or also a high-pass filter in the interstage area; i.e., between the low-noise preamplifier and the first mixing stage. Another possibility consists in replacing the remaining filtering still necessary via offset compensation in software. The solution according to the present invention is also made possible due to the fact that more recent bandpass filters of this type also meet the power compatibility requirements which must be set for a surface acoustic wave filter to be used in the front-end area in the GSM area.

Previously, that is to say before the present invention, mobile radio receivers could be implemented with a bandpass filter only if the receiver was configured as a homodyne receiver or if so-called image-rejection mixers were used which, however, have higher current consumption. These disadvantages can be avoided via the solution according to the present invention and it is possible to achieve a decisive advantage in costs and an advantage in space.

In principle, as shown in Figure 2, heterodyne radio receivers, particularly heterodyne mobile radio receivers, were configured as follows.

The output signal of an antenna was supplied to a front-end filter which preceded a preamplifier which, typically, had very low noise characteristics. The

output signal of this low-noise preamplifier was supplied to an interstage filter, the output signal of which, in turn, was supplied to the first mixing stage (first mixer).

In this arrangement, the front-end filter in the usual type of construction is normally distinguished by lower selectivity and less insertion loss in the useful band whereas the interstage filter had higher selectivity.

According to the present invention, the novel heterodyne radio receiver shown in Figure 1 is now configured in simplified manner due to the fact that a highly selective bandpass filter is used as front-end filter. The filter characteristics of the highly selective bandpass filter are so good that now only a high-pass filter or a low-pass filter is required in the interstage area; that is to say, between the low-noise preamplifier and the first mixer.

Instead of this low-pass or high-pass filter in the interstage area, offset compensation in software is also possible.

Although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the invention as set forth in the hereafter appended claims.